REMARKS/ARGUMENTS

Claims 1 through 5, and 7 through 64 are currently pending in the application.

Claims 33 through 57 were non-elected in response to a restriction requirement and have been withdrawn from consideration.

Claims 1 through 5, 7 through 32, and 58 through 64 stand rejected.

Applicant has amended independent claims 1, 10, 58, and 64, and respectfully requests reconsideration of the application.

35 U.S.C. § 102(e) Anticipation Rejections

Anticipation Rejection Based on U.S. Patent 6,074,895 to to Dery et al.

Claims 64 stands rejected under 35 U.S.C. § 102(e) as being anticipated by Dery et al. (U.S. Patent 6,074,895). Applicant respectfully traverses this rejection, as hereinafter set forth.

Applicant asserts that a claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Brothers v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is contained in the claim. *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

After considering the cited prior art, the rejection, and the Examiner's comments, Applicant has amended the claimed invention to clearly distinguish over the cited prior art.

Turning to the cited prior art, the Dery et al. reference describes the use of oxygen plasmas to remove some resin from a protective coating on a surface of an IC chip device or a surface of an organic laminate chip carrier to expose the inorganic filler in the resin to roughen the surface and induce a more hydrophilic nature to the bonding surface. The surface treatment using plasma processes can enhance adhesion between the chip surface and the encapsulant by chemical modification of the passivation layer, microroughening of the chip passivation layer and cleaning contaminants from the chip surfaces. The chemical modification of the passivation layer is the cause of the enhanced bond between the IC chip and the encapsulant. The adhesion between the chip carrier and the encapsulant is improved by microroughening of the chip carrier surface and chemical modification of the chip carrier surface. In Dery et al. an organic-based emcapsulant (underfill) is used between between the IC chip and the chip carrier to reduce the

thermal mismatch problem between the expansion rate of the IC chip and the chip carrier during the operation of the IC chip as the primary failure mechanism in flip-chip-on-board assemblies is delamination at the interface between the active face of the IC chip and the encapsulant. When adhesion is lost, the solder joints between the IC chip and the chip carrier are subjected to the stress of the thermal mismatch.

Applicant asserts that the Dery et al. reference does not anticipate the presently claimed invention of presently amended independent claim 64 because the Dery et al. reference does not identically describe each and every element as set forth in the claim, either expressly or inherently described, in as complete detail as is contained in the claim. Applicant asserts that the Dery et al. reference does not identically describe, either expressly or inherently, the elements of the presently claimed invention of presently amended independent claim 64 calling for "applying a essentially uniform liquid wetting agent layer having a thickness of about a monolayer to at least one of said surface of said semiconductor device and said surface of said substrate" and "applying a flowable underfill material between the substrate and the semiconductor device separately from said liquid wetting agent layer, such that said flowable material contacts said wetting agent layer".

In contrast to the elements of the presently claimed invention of presently amended independent claim 64, the Dery et al. reference describes the use of oxygen plasmas to remove resin from a protective coating on a surface of an IC chip device or a surface of an organic laminate chip carrier to expose the inorganic filler in the resin to roughen the surface and induce a more hydrophilic nature to the bonding surface to enhance adhesion between the chip surface and the encapsulant by microroughening of the chip passivation layer and cleaning contaminants from the chip surface. In Dery et al., the adhesion between the chip carrier and the encapsulant is improved by microroughening of the chip carrier surface and chemical modification of the chip carrier surface. In Dery et al. an organic-based emcapsulant (underfill) is used between between the IC chip and the chip carrier to reduce the thermal mismatch problem between the expansion rate of the IC chip and the chip carrier during the operation of the IC chip as the primary failure mechanism in flip-chip-on-board assemblies is delamination at the interface between the active face of the IC chip and the encapsulant.

Applicant asserts that Dery et al. does not describe applying a essentially uniform liquid wetting agent layer having a thickness of about a monolayer to at least one of said surface of said semiconductor device and said surface of said substrate whatsoever. Therefore, Dery et al. does not anticipate presently amended independent claim 64. Accordingly, presently amended independent claim 64 is allowable.

35 U.S.C. § 103(a) Obviousness Rejections

Obviousness Rejection Based on U.S. Patent 6,074,895 to Dery et al.

Claim 64 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Dery et al. (U.S. Patent 6,074,895. Applicant respectfully traverses this rejection, as hereinafter set forth.

M.P.E.P. 706.02(j) sets forth the standard for a Section 103(a) rejection:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, **the prior art reference (or references when combined) must teach or suggest all the claim limitations.** The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). (Emphasis added).

After considering the cited prior art, the rejection, and the Examiner's comments, Applicant has amended independent claims 1, 10, 58 and 64 and asserts that previously presented independent claim 62 clearly distinguish over the cited prior art.

Again, turning to the cited prior art, the Dery et al. reference teaches or suggests the use of oxygen plasmas to remove some resin from a protective coating on a surface of an IC chip device or a surface of an organic laminate chip carrier to expose the inorganic filler in the resin to roughen the surface and induce a more hydrophilic nature to the bonding surface. The surface treatment using plasma processes can enhance adhesion between the chip surface and the encapsulant by chemical modification of the passivation layer, microroughening of the chip passivation layer and cleaning contaminants from the chip surfaces. The chemical modification

of the passivation layer is the cause of the enhanced bond between the IC chip and the encapsulant. The adhesion between the chip carrier and the encapsulant is improved by microroughening of the chip carrier surface and chemical modification of the chip carrier surface. In Dery et al. an organic-based emcapsulant (underfill) is used between between the IC chip and the chip carrier to reduce the thermal mismatch problem between the expansion rate of the IC chip and the chip carrier during the operation of the IC chip as the primary failure mechanism in flip-chip-on-board assemblies is delamination at the interface between the active face of the IC chip and the encapsulant. When adhesion is lost, the solder joints between the IC chip and the chip carrier are subjected to the stress of the thermal mismatch.

Applicant asserts that the Dery et al. reference does not establish a *prima facie* case of obviousness regarding the presently claimed invention of presently amended independent claim 64 because the Dery et al. reference does not teach or suggest all the claim limitations of the claimed invention. Applicant asserts that the Dery et al. reference does not teach or suggest the claim limitations of the presently claimed invention of presently amended independent claim 64 calling for "applying a essentially uniform liquid wetting agent layer having a thickness of about a monolayer to at least one of said surface of said semiconductor device and said surface of said substrate" and "applying a flowable underfill material between the substrate and the semiconductor device separately from said liquid wetting agent layer, such that said flowable material contacts said wetting agent layer".

In contrast to the claim limitations of the presently claimed invention of presently amended independent claim 64, the Dery et al. reference teaches or suggests the use of oxygen plasmas to remove resin from a protective coating on a surface of an IC chip device or a surface of an organic laminate chip carrier to expose the inorganic filler in the resin to roughen the surface and induce a more hydrophilic nature to the bonding surface to enhance adhesion between the chip surface and the encapsulant by microroughening of the chip passivation layer and cleaning contaminants from the chip surface.

Applicant asserts that Dery et al. does not teach or suggest applying a essentially uniform liquid wetting agent layer having a thickness of about a monolayer to at least one of said surface of said semiconductor device and said surface of said substrate whatsoever. Therefore, Dery et al. does not establish a *prima facie* case of obviousness under 35 U.S.C. § 103 regarding

presently amended independent claim 64. Accordingly, presently amended independent claim 64 is allowable.

Obviousness Rejection Based on U.S. Patent 6,074,895 to Dery et al. and U.S. Patent 4,231,910 to Pluddemann

Claims 1 through 5, 7 through 12, 15, 22, and 58 through 64 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Dery et al. (U.S. Patent 6,074,895) and Pluddemann (U.S. Patent 4,231,910). Applicant respectfully traverses this rejection, as hereinafter set forth.

M.P.E.P. 706.02(j) sets forth the standard for a Section 103(a) rejection:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, **the prior art reference (or references when combined) must teach or suggest all the claim limitations.** The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). (Emphasis added).

Again, turning to the cited prior art, the Dery et al. reference teaches or suggests the use of oxygen plasmas to remove some resin from a protective coating on a surface of an IC chip device or a surface of an organic laminate chip carrier to expose the inorganic filler in the resin to roughen the surface and induce a more hydrophilic nature to the bonding surface. The surface treatment using plasma processes can enhance adhesion between the chip surface and the encapsulant by chemical modification of the passivation layer, microroughening of the chip passivation layer and cleaning contaminants from the chip surfaces. The chemical modification of the passivation layer is the cause of the enhanced bond between the IC chip and the encapsulant. The adhesion between the chip carrier and the encapsulant is improved by microroughening of the chip carrier surface and chemical modification of the chip carrier surface. In Dery et al. an organic-based emcapsulant (underfill) is used between between the IC chip and the chip carrier to reduce the thermal mismatch problem between the expansion rate of the IC chip and the chip carrier during the operation of the IC chip as the primary failure mechanism in flip-chip-on-board assemblies is delamination at the interface between the active face of the IC

chip and the encapsulant. When adhesion is lost, the solder joints between the IC chip and the chip carrier are subjected to the stress of the thermal mismatch. Dery et al. does not teach or suggest the use of a liquid wetting agent for any purpose whatsoever. In Dery et al. the encapsulant material (underfill) is a thermo-setting type material.

The Plueddemann reference teaches or suggests a primer composition for improving adhesion between a solid substrate and a thermo-plastic resin. The composition consists essentially of 1 to 25 weight percent of an organosilicon compound selected from a group of silane compounds or partial hydrolyzates thereof and 75 to 99 weight percent of an alkoxymethylitriazine. Plueddemann teaches an improved wet and dry adhesion of thermoplastics to solid substrates. All the examples of the Plueddeman reference, Examples 1 through 7, illustrate the use of a primer composition with a thermo-plastic material, not a thermo-setting material. The primer compound of Plueddemann is not directed to an improved flow of an underfill material that is a thermo-setting material. Applicant asserts that an underfill material is clearly a thermo-setting material, not a thermo-plastic material. In contrast to a thermo-setting material, a thermo-plastic material is a material capable of being repeatedly softened by an increase of temperature and hardened by a decrease in temperature. A thermo-plastic material substantially physically changes upon heating rather than having a chemical change so that in the softened stage the thermo-plastic material can be shaped by flow into articles by molding or extrusion. Thermo-plastic materials are too viscous to be used as underfill materials because the high viscosity of the thermo-plastic material prevents the material from flowing into small spaces, such as the 125 microns or less space between a IC chip mounted by solder balls on an IC chip carrier.

In contrast, a thermo-setting material is a plastic that, when cured by application of heat or chemical means, changes into a substantially infusible and insoluble material. Thermo-setting materials are used as underfill materials for their substantially infusible and insoluble characteristics to protect the connections between IC chips mounted on an IC carrier using solder balls from environmental attach and to reduce the thermal mismatch problem between the expansion rate of the IC chip and the chip carrier during the operation of the IC chip.

Applicant asserts that any combination of the Dery et al. reference and the Plueddeman reference cannot and does not establish a *prima facie* case of obviousness under 35 U.S.C. § 103

regarding the presently claimed inventions of presently amended independent claims 1, 10, 58, and 64 as well as previously presented independent claim 62 because any combination of the cited prior art does not teach or suggest all the claim limitations, because any combination of the cited prior art teaches away from any combination thereof, and any suggestion for any combination of the cited prior art is based solely upon Applicant's disclosure and cannot be contained in the cited prior art as the cited prior art teaches away from any combination thereof.

Applicant asserts that any combination of the Dery et al. reference and the Plueddeman reference fails to teach or suggest the claim limitations of presently amended independent claims 1, 10, 58, and 64 as well as the claim limitations of the previously presented independent claim 62 calling for "applying a liquid wetting agent layer to one of said surface of said semiconductor device and said surface of said substrate", "applying a flowable underfill material between the substrate and the semiconductor device, such that said flowable material contacts said liquid wetting agent layer", "applying a liquid wetting agent layer to one of said active surface of said semiconductor device and said upper surface of said substrate", "applying a liquid wetting agent layer to one of said active surface of said semiconductor device and said upper surface of said substrate", "applying a silane-based material layer to one of a portion of said active surface of said semiconductor device and a portion of said upper surface of said substrate", "applying a flowable underfill material between said semiconductor device and said substrate, such that said flowable underfill material contacts said applied silane-based material layer", "applying a essentially uniform liquid wetting agent layer having a thickness of about a monolayer to at least one of said surface of said semiconductor device and said surface of said substrate", and "applying a flowable underfill material between the substrate and the semiconductor device separately from said liquid wetting agent layer, such that said flowable material contacts said wetting agent layer".

Applicant asserts that the Dery et al. reference clearly uses a thermo-setting material as an underfill material because the Dery et al. reference teaches or suggests that an organic-based encapsulant (underfill) is used between the IC chip and the chip carrier to reduce the thermal mismatch problem between the expansion rate of the IC chip and the chip carrier during the operation of the IC chip as the primary failure mechanism in flip-chip-on-board assemblies is delamination at the interface between the active face of the IC chip and the encapsulant. When

adhesion is lost, the solder joints between the IC chip and the chip carrier are subjected to the stress of the thermal mismatch.

Applicant further asserts that the Dery et al. reference cannot teach or suggest the use of a thermo-plastic underfill because a thermo-plastic underfill would soften with an increase of temperature when the IC chip is being operated so that the thermo-plastic underfill would be unable to compensate for any thermal mismatch between IC chip and the IC carrier thereby making the Dery et al. invention inoperable due to the thermo-plastic material loosing its strength as it is heated. Additionally, thermo-plastic materials have too high viscosity to be used as underfill materials as they are unable to effectively fill the small space between an IC chip mounted on an IC chip carrier using solder balls where the small space is 125 microns or less in height. Further, the primer composition would not roughen any surface in the Dery et al. reference.

Applicant yet further asserts that the Plueddeman reference is solely and only directed to the use of a primer composition with thermo-plastic materials, not thermo-setting materials, such as underfill. Applicant asserts that there is no reference to thermo-setting materials in the Plueddeman reference whatsoever.

Applicant asserts that without any teaching whatsoever regarding the use of a primer composition with thermo-setting material, the Plueddeman reference teaches away from any combination with and modification of the Dery et al. reference. Yet further, Applicant asserts that one of ordinary skill in the art would not substitute the use of a thermo-plastic for the underfill of Dery et al. Applicant asserts the one of ordinary skill in the art would not substitute the liquid primer composition from the Plueddeman reference to be separately applied to the IC chip and/or IC carrier of the Dery et al. reference in place of the oxygen plasma of the Dery et al. reference that removes some resin from a protective coating on a surface of an IC chip device or a surface of an organic laminate chip carrier to expose the inorganic filler in the resin to roughen the surface. Applicant asserts that the substitution of a liquid primer composition from the Plueddeman reference for a plasma removal process of the Dery et al. reference cannot be the substitution of an equivalent. Applicant asserts that one of ordinary skill in the art would not use a liquid primer composition used with thermo-plastic resins for a plasma removal process for use with thermo-setting plastics.

Applicant asserts that the Dery et al. reference teaches or suggests the use of a plasma to remove a portion of the underfill resin while the Plueddeman reference teaches or suggests the use of an additional liquid primer composition with a thermo-plastic material that is unsuited for use with an underfill material.

Therefore, Applicant asserts that any combination of the Dery et al. reference and the Plueddeman reference cannot and does not establish a *prima facie* case of obviousness under 35 U.S.C. § 103 regarding the presently claimed inventions of presently amended independent claims 1, 10, 58, and 64 as well as previously presented independent claim 62.

Applicant further asserts that the teachings of the Dery et al. reference and the Plueddeman reference clearly teach away from each other because the Dery et al. reference is teaches or suggests the use of an underfill that is a thermo-setting resin while the Plueddeman reference teaches or suggests of a liquid primer composition with a thermo-plastic material incapable of being used as an underfill. Further, the Plueddeman reference does not make any reference whatsoever to the use of a liquid primer composition with a thermo-setting material. Yet further, neither the Dery et al. reference nor the Plueddeman reference contains any suggestion whatsoever as to the substitution of a liquid primer composition for thermo-plastic material for a plasma used to remove material from a surface of an IC chip and/or an IC chip carrier.

Therefore, Applicant asserts that any combination of the Dery et al. reference and the Plueddeman reference cannot and does not establish a *prima facie* case of obviousness under 35 U.S.C. § 103 regarding the presently claimed inventions of presently amended independent claims 1, 10, 58, and 64 as well as previously presented independent claim 62 because the cited prior art teaches away from any combination thereof.

Applicant asserts that the sole teaching or suggestion for the use of a liquid wetting agent on one of the active surface of said semiconductor device and a portion of said upper surface of said substrate for use with an underfill material that must be a thermo-setting material is solely the Applicant's disclosure because the cited prior art teaches away from any combination thereof, because if the prior art is combined as suggested in the rejection, the combination clearly destroys the operability of the primary reference, and because the cited prior art does not contain

any suggestion for any combination thereof where a thermo-plastic resin and a liquid primer composition can be substituted for a thermo-setting resin and a plasma removal process.

Therefore, Applicant asserts that any combination of the Dery et al. reference and the Plueddeman reference cannot and does not establish a *prima facie* case of obviousness under 35 U.S.C. § 103 regarding the presently claimed inventions of presently amended independent claims 1, 10, 58, and 64 as well as previously presented independent claim 62.

Obviousness Rejection Based on U.S. Patent 6,074,895 to Dery et al. and U.S. Patent 4,231,910 to Pluddemann, and further in combination with U.S. Patent 5,766,982 to Akram et al.

Claims 13, 14, 16 through 21, and 23 through 30 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Dery et al. (U.S. Patent 6,074,895) and Pluddemann (U.S. Patent 4,231,910), and further in combination with Akram et al. (U.S. Patent 5,766,982). Applicant respectfully traverses this rejection, as hereinafter set forth.

Applicant asserts that such dependent claims are allowable as they depend from allowable presently amended independent claim 1 and 10 for the reasons set forth hereinabove.

Obviousness Rejection Based on U.S. Patent 6,074,895 to Dery et al. and U.S. Patent 4,231,910 to Pluddemann, and further in combination with U.S. Patent 5,203,076 to Banerji et al.

Claims 31 and 32 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Dery et al. (U.S. Patent 6,074,895) and Pluddemann (U.S. Patent 4,231,910), and further in combination with Banerji et al. (U.S. Patent 5,203,076). Applicant respectfully traverses this rejection, as hereinafter set forth.

Applicant asserts that such dependent claims are allowable as they depend from allowable presently amended independent claim 1 and 10 for the reasons set forth hereinabove.

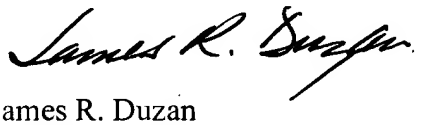
ENTRY OF AMENDMENTS

The amendments to claims above should be entered by the Examiner because the amendments are supported by the as-filed specification and drawings and do not add any new matter to the application.

CONCLUSION

Claims 1 through 5, 7 through 32, and 56 through 64 are believed to be in condition for allowance, and an early notice thereof is respectfully solicited. Should the Examiner determine that additional issues remain which might be resolved by a telephone conference, he is respectfully invited to contact Applicant's undersigned attorney.

Respectfully submitted,



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